

RIFLE WITH STRAIGHT PULL BOLT ACTION

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Abstract

A rifle having a straight pull bolt assembly with a bolt handle that extends outward and downward from a bolt operation mechanism. The bolt handle rotatable a limited rotational range forward and rearwardly about a horizontal axis for operating the mechanism. The handle can be reconfigured to position its rotational range about the horizontal axis and can be attached to the mechanism at either left or right sides to provide for ambidextrous operation. Bolt heads, lower frame members with magazine wells, and barrel assemblies can be readily swapped to change ammunition. The bolt assembly can be unlocked by firing or by a thumb push button release at the backside of the mechanism. A bolt removal release mechanism is forward of the thumb pushbutton and an ejector includes a spring bias and cam follower surface to reliably eject casings.

Background/Summary

RELATED APPLICATIONS

[0001] This application claims priority to and is a continuation-in-part of PCT/US2020/040792 filed Jul. 2, 2020, which claims priority to U.S. Provisional Application 62/870,017 filed Jul. 2, 2019. Said applications are incorporated by reference herein in their entireties.

BACKGROUND OF THE INVENTION

[0002] The conventional four motion bolt action is the most common manually operated cycling mechanism used in rifles. During the initial firing of the cartridge, the bolt is locked at an in-battery position. After firing, the bolt action handle is raised upwardly rotating the bolt about the barrel axis to unlock the bolt and is then pulled rearwardly. As the bolt moves rearward the fired empty cartridge is extracted from the firing chamber. After the spent cartridge is ejected, the bolt is moved forward, by the bolt handle, engaging the next cartridge in the magazine and pushing that cartridge into the chamber. The bolt handle is then rotated downwardly locking the bolt in the in-battery firing position. The torque required to lock and unlock the bolt assembly, by raising and lowering the bolt handle is not insignificant and can cause rotational movement of the firearm and generally move the firearm off of its target, requiring re-sighting.

[0003] Straight pull rifles reduce the number of motions to essentially two motions for cycling the firearm. The locking of the bolt head into the barrel or barrel extension is by means other than the user rotating the bolt action handle about the barrel axis. In that the two upward and downward motions of the bolt handle are not needed there is more stability in holding the firearm.

[0004] Thus, straight pull rifle actions are generally mechanically more complicated than four motion bolt action rifles and are typically much more expensive. The increased mechanical complexity applies to the bolt operational mechanisms, operational controls, firearm disassembly steps, and convertibility to different calibers and cartridges where available. Bolt removal releases and bolt unlock controls often are not intuitive or readily accessed. Generally, straight pull rifles, like conventional four motion bolt action rifles are not convertible from right to left handed operation of the bolt. Any new improvements in straight pull rifles that improve on speed of operation, ergonomics, ease in finding the operational controls, convertibility from right to left handed use and vice versa, flexibility in changing calibers, less complexity in making modifications, particularly with no tools or minimal tools, and providing a robust action that can be manufactured for less than competitive straight pull rifles, would be welcomed in the marketplace.

SUMMARY OF THE INVENTION

[0005] A straight pull bolt action rifle comprises a bolt assembly mounted in a receiver, in a stock, with a trigger mechanism positioned below the bolt assembly, a barrel and barrel extension secured forward of the receiver to receive a bolt head of the bolt assembly. Locking of the bolt action in the ready-to-fire position is by way of a short rotation forward in an arcuate path about a horizontal axis of the bolt handle that is a continuation of the forward linear motion of the bolt assembly and bolt handle in chambering a cartridge. Unlocking of the bolt action after firing or to eject a cartridge utilizes a short opposite rotation of the bolt handle in an arcuate path about a horizontal axis and then the rearward linear motion of the bolt assembly including the bolt handle. The minimal arcuate paths of the bolt handle motion rearwardly combined with the linear motion of the bolt body sliding in the receiver is such that the overall motions, including the arcuate motions, are appropriately termed straight.

[0006] In embodiments, enhanced ergonomics is provided by the bolt handle being readily swappable between the left and right sides of the bolt assembly and by being angularly adjustable on each side. Further enhanced ergonomics being provided by one or more of a thumb pushbutton for unlocking the bolt handle and bolt when in the in-battery ready-to-fire position, the thumb button within reach by the user's hand while grasping the bolt handle, an ambidextrous tang safety is positioned directly below

and behind the bolt assembly, and a bolt assembly pull-out release lever is directly forward of the rotation axis of the bolt handle on the receiver for removal of the bolt.

[0007] The bolt assembly comprising a bolt carrier containing a bolt body, a bolt head, a bolt plunger, a striker, a firing pin, a firing pin spring, a rear bolt enclosure, a bolt operation mechanism, and the bolt handle connecting to the bolt operation mechanism at the rear bolt enclosure. In embodiments, the bolt head having a plurality of locking roller balls that are releasably engageable with recesses in the barrel extension and lockable therein by the bolt plunger.

[0008] A feature and advantage of embodiments is a rifle having a straight pull bolt action with improved ergonomics and functionality. The straight pull bolt action eliminates two of the four motions required to cycle a rifle compared to a traditional four motion bolt action resulting in faster ejection and loading as well as more gun stability during the cycling, less re-aiming, and improved accuracy in shooting.

[0009] In embodiments, functional operation and control of the straight pull rifle action is through the bolt operation mechanism in an enclosure at the rearward end of the bolt assembly configured as a bolt assembly cap. The bolt operation mechanism providing for all or some of the following functions: locking the bolt in the in-battery position, providing the final locking of the bolt with a plunger a gradual final locking, unlocking the bolt from the in-battery position manually or upon firing, manually unlocking the bolt at the in-battery position at a gradual reduced travel rate, locking the bolt handle forwardly, releasing the forward locked bolt handle manually, releasing the forward locked bolt handle by pulling the trigger, providing a manual gradual initial push off of the bolt assembly from the receiver at the closed most forwardly position of the bolt assembly after firing or after a manual bolt handle release, locking the bolt handle in the rearward rotational position, unlocking the bolt handle from the rearward rotational position, and compressing the firing pin spring utilizing the bolt handle. The gradual locking of the bolt head and gradual unlocking and gradual push-off of the receiver providing smooth operation and less jarring of the rifle in cycling the action. Moreover, no or minimal rotational torque about the longitudinal axis of the rifle is caused by the cycling of the firearm.

[0010] A feature and advantage of embodiments is a bolt assembly having a downwardly angled bolt handle extending from a rear end of the bolt assembly on a bolt cap initially positioned and configured like a bolt of a conventional four motion bolt action rifle. The bolt having a rotation axis at the rear bolt cap about a horizontal axis of about 45 degrees, plus or minus 15 degrees. From a forwardly most rotation position of the bolt handle, where the bolt is in-battery and the bolt assembly locked forward, the bolt handle is manually released or automatically released and the bolt handle is rotated rearwardly to the rearwardly most rotation position unlocking the bolt assembly from the receiver and barrel extension. The bolt is then pulled rearwardly sliding the bolt assembly rearwardly, ejecting the spent casing or unfired cartridge, to a rearwardly most bolt assembly position with the bolt handle being rotationally locked in the rearwardly most rotational position. The bolt handle is then pushed forwardly, loading the next cartridge, with no bolt handle rotation, to where the bolt cap engages the receiver, the bolt handle continues to be pushed forward thereby rotating the bolt handle, locking the bolt assembly to the receiver and barrel extension, and locking the bolt handle in the forwardly most rotation position, putting the rifle in a ready-to-fire mode.

[0011] A feature and advantage of embodiments is the minimal bolt handle rotation is continuous with the forward and rearward sliding of the bolt assembly but is mostly distinct therefrom. In embodiments, a pushbutton at the rear side of the bolt cap releases the bolt handle when the bolt assembly is locked in the forward most position. The button positioned in close proximity to the bolt handle such that the pushbutton is pushable with the user's thumb while the user's fingers of the same hand are hooked onto the bolt handle. The depression of the pushbutton with the release of the locked bolt handle, and the rearward pulling of the bolt handle and opening of the bolt assembly can be accomplished in one smooth continuous motion. The handle being used as an anchor point providing leverage for the pushing the pushbutton while simultaneously commencing the rearward force to move the bolt handle rearwardly.

[0012] In embodiments, select ones or all of the above functions are keyed off of a main rotatable drive member that is connected directly to the bolt handle and that rotates with the bolt handle about a horizontal axis (where the barrel axis is horizontal and the gun is upright). In embodiments, the main rotatable drive member rotatably fixed to the bolt carrier and being part of four separate linkage systems. The rotation about a horizontal axis providing a mechanical advantage in operating several functionalities with a plurality of linkages connected to the main rotatable drive member. The rotation of the main rotatable drive member is limited to a partial rotation, for example, a rotation range of 30 to 80 degrees, forward and rearward. The rotation of the bolt handle effecting the rotation of the main rotatable drive member being a smooth uninterrupted continuation of the linear rearward ejection motion and linear forward loading motion of the bolt assembly effected by the bolt handle.

[0013] A first linkage system is a sliding toggle mechanism with a first link being the main rotatable drive member, the second link pinned to the main rotatable drive member at an outward first arm of the main rotatable drive member and connecting to a slider at the other end, the slider being the bolt plunger. The first and second links being constrained within the bolt assembly and having an over center position of the pivots that correspond to the bolt plunger being extended and holding the locking roller balls into engagement with the barrel extension thereby locking the bolt head in the in-battery position. The second link also having cam surfaces thereon that receive a bias inward toward the first link by a spring member that maintains the over center position of the linkage. The first linkage system for locking and releasing the bolt in the in-battery position and providing the reduced travel rate for said locking and releasing; for locking the bolt handle in the rearward most position.

[0014] A second linkage system is a toggle slider linkage with a second arm of the main rotatable drive member defining a first link, a second link pinned to the first link, a third link pinned to the second link. The second and third links slidably constrained at the upper wall of the mechanism housing, the upper wall providing a cam surface. The third link having a catch portion for engagement with a catch surface on the receiver and being spring loaded to follow the cam surface of the mechanism housing and for catching the catch surface on the receiver. The second linkage system providing a gradual push off and separation of the rearward end of the bolt assembly from the receiver for initiating the ejection cycle, and for keeping the bolt in a closed position when the bolt is in the in-battery position.

[0015] A third linkage system is a cam and two link system for compressing the firing pin spring in preparation for firing, utilizing rotation of the bolt handle. The cam is provided by a surface on the main rotatable drive member, in embodiments the cam surface is on the first arm that is also a link in the first linkage system. The rotation of the main rotatable drive member, rotatably fixed to the bolt body, provides a cam surface that pushes a first link (the striker) rearwardly, the striker pinned to the firing pin such that as the striker and firing pin are pulled rearwardly within the bolt body the firing pin spring is compressed, the firing pin spring having a rearward end anchored to the bolt body. The striker is subsequently engaged by the sear to hold the firing pin spring in the compressed state.

[0016] A fourth linkage system is a catch and release mechanism for locking the handle forwardly when the bolt is in the in-battery ready-to-fire position and for providing a push button release button accessible by the thumb for releasing the bolt handle from said position. The main rotatable member providing a handle lock projection. A lever (the thumb pushbutton) is pivotal on the mechanism housing and is pinned to a push button actuation link, the push button actuation link having a cam follower surface that is engaged by a cam surface on the rearward end of the striker, such that as the striker is pulled back by way of the third linkage, the push button actuation link causes a lower end of the thumb pushbutton lever to move towards the main rotatable member to catch and secure the handle lock projection, locking the rotation of the rotatable member in place, thereby locking the bolt handle in the forwardly most position of the bolt handle.

[0017] In embodiments, the rifle retains the advantages of a rotating bolt handle, for example, the locking and unlocking of the bolt assembly, but with a downwardly bolt handle, and with a rotation motion that is a continuation or commencement of the linear pull back or forward push during cycling of the bolt action. In embodiments, the rotation range of the bolt handle can be from 90 degrees to 20

degrees. In embodiments, the straight pull bolt action providing for faster, smoother, and more reliable reloading of consecutive cartridges than conventional bolt actions or other straight pull actions.

[0018] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a repositionable bolt handle that can be repositioned on both the left and right sides of the bolt for ambidextrous operation of the straight pull bolt action. In embodiments an ambidextrous tang safety is provided directly behind and below the rearward end of the bolt assembly.

[0019] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a repositionable bolt handle that can be repositioned at different angles from horizontal for ergonomic operation of the straight pull bolt action.

[0020] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a detachable bolt handle that can be removed quickly and easily without tools. In embodiments, removal of the bolt handle renders the firearm inoperable for security and safe storage of firearm. In embodiments, a removable handle is provided to secure firearm and to prevent unintended use of the firearm.

[0021] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a linkage designed to use leverage for locking the bolt and for unlocking the bolt.

[0022] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a bolt with a quickly detachable bolt head. In embodiments, the caliber of the firearm can be changed by removing a first bolt head and replacing it with a second bolt head. In embodiments, the first bolt head is dimensioned and configured for a first caliber and the second bolt head is dimensioned and configured for a second caliber different from the first caliber. In embodiments, the quickly detachable bolt head provides for simple and fast caliber conversion.

[0023] In embodiments, when the bolt head is swapped out, a first barrel assembly with a barrel sized for the first caliber may be swapped out for a second barrel assembly with a second barrel sized for the second caliber. In embodiments, the respective barrel assemblies are not disassembled. Each barrel assembly comprising a barrel with a threaded end threaded onto a barrel extension and secured thereto by a barrel nut on the barrel threaded end tightened onto a forward face of the barrel extension with a barrel lug positioned between the barrel nut and the forward face of the barrel extension. The barrel assemblies are preassembled to provide the correct head spacing at the factory. The barrel lugs on each barrel interface with a forward surface of the receiver, for example a vertical rib on the barrel lugs fit into a corresponding groove on the forward face of the receiver. The receiver having a barrel assembly clamping portion where the generally tubular receiver has longitudinal slit whereby the forward receiver clamping portion has a C shape. A plurality of screws and barrel nuts pull the opposing sides of the clamping portion together on the outer cylindrical surface of the barrel extension with one barrel nut registering in a groove cut in the bottom of the barrel extensions of the barrel assemblies. A feature and advantage is that the barrel lug with the interface rib interfacing with the forward face of the receiver establishes the relative and correct rotational position and the correct relative axial location, along with the barrel nut interfacing with the barrel extension groove.

[0024] A feature and advantage of embodiments is a rifle having a straight pull bolt action with an automatic locking bolt handle when rifle is cocked and cartridge loaded, and with a release button on back of the bolt for unlocking the locked bolt handle.

[0025] A feature and advantage of embodiments is a rifle having a straight pull bolt action having a pre-extraction plunger design with bolt handle lock back.

[0026] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a single step release of a bolt stop. In embodiments, a releasable bolt stop requires first a sliding forward motion before an inward depression to release the bolt assembly from the receiver.

[0027] A feature and advantage of embodiments is a rifle having a straight pull bolt action with cam and spring activated fixed ejection arrangement.

[0028] A feature and advantage of embodiments is a rifle having a straight pull bolt action that provides for a tool-less bolt assembly/disassembly process.

[0029] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a positionable handle that allows for ergonomic operation.

[0030] A feature and advantage of embodiments is a rifle having a straight pull bolt action incorporating a linkage design that enables tight closure of breech. In embodiments, the tight closure of the breech provides improved accuracy.

[0031] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a barrel nut swing process applied to a barrel with an extension for adjustable head spacing and quick barrel conversion.

[0032] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a bolt handle lock that locks the bolt closed when the rifle is cocked to avoid being accidentally knocked open. In embodiments, the bolt handle lock can be quickly released for opening without firing if needed.

[0033] A feature and advantage of embodiments is a rifle having a straight pull bolt action including a unique plunger design for casing pre-extraction.

[0034] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a simple releasable bolt stop design that provides for easy manipulation and ready accessibility. A feature and advantage of embodiments is a rifle having a straight pull bolt action with a cam surface that cooperates with a spring to place the ejection arm in a desired position.

[0035] A feature and advantage of embodiments is a rifle having a straight pull bolt action designed to facilitate simple tool-less assembly. In embodiments, bolt components are configured to assist in assembly.

[0036] A feature and advantage of embodiments is a rifle that is configured to receive a magazine holding a plurality of cartridges to be fired by the rifle. In embodiments, the use of removable magazines allows a plurality of cartridges to be easily loaded into the rifle by inserting a single magazine into the firearm. In embodiments, the rifle that is configured to receive Accuracy International Chassis System (AICS) magazines.

[0037] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine well adaptor plate for long action AICS magazines.

[0038] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine release button extension for short action AICS magazines.

[0039] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a steel plate that is used to control the AICS magazine height and eliminate wear on the receiver.

[0040] A feature and advantage of embodiments is a rifle having an aluminum receiver for reduced weight.

[0041] A feature and advantage of embodiments is the bolt operation mechanism being substantially contained in a bulbous housing at the rearward end of the bolt assembly, the bulbous housing may be formed of polymer and may provide support and components for the bolt operation mechanism and the linkages associated therewith. For example, the bulbous housing may provide a pivot pin support base for a bolt lock release thumb pushbutton, and for example, the bulbous housing may provide a

cam surface and containment of a linkage providing a gradual bolt assembly-receiver separation, in particular a linkage to push the bolt assembly away from the receiver. The bolt lock release button may be configured as a rocker lever/switch formed of the same material, for example a polymer as the bulbous housing.

[0042] A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine catch/release located on the trigger guard of the rifle. In embodiments, the magazine catch is extended for use with short magazines. In embodiments the trigger guard has a narrowed portion and the magazine catch/release has a pushbutton with a conforming slot to receive the trigger guard at the narrowed portion. In embodiments, a catch portion is displaced forwardly from the pushbutton by a slider mechanism.

[0043] In embodiments herein, improvements are provided in straight pull rifles relating to speed of operation, ergonomics, ease in finding the operational controls, easy convertibility from right to left handed use and vice versa, flexibility in changing ammunition, and less complexity in making such conversions to different ammunition, particularly with no tools or minimal tools, and providing a robust action that can be manufactured for less than competitive straight pull rifles.

[0044] The above summary of the various representative embodiments of the invention is not intended to describe each illustrated embodiment or every implementation of the invention. Rather, the embodiments are chosen and described so that others skilled in the art can appreciate and understand the principles and practices of the invention. The Figures in the detailed description that follow more particularly exemplify these embodiments.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The invention can be completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

[0046] FIG. 1A is a perspective view showing a straight pull rifle according to embodiments.

[0047] FIG. 1B is a perspective view of the straight pull rifle of FIG. 1 and with a kit for changing the configuration of the rifle for a different ammunition.

[0048] FIG. 2A is a side perspective view of a straight pull rifle with the receiver and stock removed showing the mechanisms of the rifle.

[0049] FIG. 2B is the receiver removed from the straight pull rifle of FIG. 2A.

[0050] FIG. 2C is a side perspective view of the straight pull rifle of FIG. 1A with the stock removed revealing mechanisms.

[0051] FIG. 2D is a side perspective view of the rifle of FIG. 2C from the opposite side and without the receiver.

[0052] FIG. 2E is the receiver of the rifle of FIG. 2D.

[0053] FIG. 2F is an exploded view of the connection system of a straight pull rifle between the receiver and a barrel assembly.

[0054] FIG. 2G is a perspective view of the receiver of FIG. 2F.

[0055] FIG. 2H is a perspective view of the barrel lug of FIG. 2F.

[0056] FIG. 2I is a cross-sectional view of the barrel extender of FIG. 2F.

[0057] FIG. 3 is an exploded view of a straight pull rifle.

[0058] FIG. 4A is a perspective view of a portion of a straight pull rifle with a releasable bolt stop.

[0059] FIG. 4B is an exploded view of the releasable bolt stop mechanism of FIG. 4A.

[0060] FIG. 4C is a perspective view of the mechanism of FIG. 4a without the bolt stop insert housing.

[0061] FIG. 4D is a perspective view of another embodiment of a releasable bolt stop.

[0062] FIG. 4E is a perspective view of the releasable bolt stop of FIG. 4D with the receiver removed.

[0063] FIG. 4F is a perspective view of the bolt stop of FIG. 4D with the bolt stop insert removed showing the engagement with the bolt stop groove in the bolt body.

[0064] FIG. 4G is an exploded perspective view of the bolt stop insert and other components of the bolt stop of FIG. 4D.

[0065] FIG. 4H is a perspective view of a lower frame of a straight pull rifle with a magazine well and magazine release lever nested around the trigger guard.

[0066] FIG. 4I is another perspective view of the lower frame of FIG. 4H.

[0067] FIG. 4J is an exploded perspective view of the lower frame of FIGS. 4I and 4J.

[0068] FIG. 4K is a perspective view of the components of the magazine release mechanism.

[0069] FIG. 5A is an exploded view of a bolt assembly of a straight pull rifle.

[0070] FIG. 5B is a perspective view of a bolt assembly of a straight pull rifle.

[0071] FIG. 5C is another perspective view of the bolt assembly of FIG. 5A.

[0072] FIG. 5D is an exploded view of the bolt assembly of FIG. 5A.

[0073] FIG. 5E is a perspective view of a bolt handle showing mechanisms to remove the bolt handle from the bolt assembly.

[0074] FIG. 5F is a perspective view of the bolt handle of FIG. 5E with a bolt handle cap removed.

[0075] FIG. 5G is a perspective view of the bolt handle of FIGS. 5E and 5G with a bolt handle post removed.

[0076] FIG. 6A is a perspective view illustrating that a bolt body can receive different bolt heads.

[0077] FIG. 6B is a perspective view of the forward end of a bolt assembly of a rifle.

[0078] FIG. 6C is a perspective view of the bolt assembly of FIG. 5F with the bolt head removed and the latch exploded.

[0079] FIG. 6D is a cross sectional view of the forward end of the bolt assembly of FIG. 5F.

[0080] FIG. 6E is a cross sectional view of the bolt assembly of FIG. 5F with the latch for releasing the bolt head actuated.

[0081] FIG. 6F is a cross sectional view of the bolt assembly of Figure 5I showing the bolt head

separating from the bolt body.

[0082] FIG. 6G is a perspective view of a bolt assembly with a ejector engaged in a groove of the bolt body.

[0083] FIG. 6H is an exploded perspective view of a bolt head.

[0084] FIG. 6I is an exploded view of the ejector mechanism of FIG. 6A.

[0085] FIG. 7A is a perspective side view of straight pull rifle with the receiver removed illustrating components.

[0086] FIG. 7B is a perspective view of the rifle of FIG. 7A with the barrel extender and bolt release insert removed.

[0087] FIG. 7C is a perspective view of the rifle of FIG. 7B with the bolt body removed.

[0088] FIG. 7D is a perspective view of the rifle of FIG. 7C with the bolt handle removed.

[0089] FIG. 8 is a perspective view of the components of a first linkage system.

[0090] FIG. 9 is an exploded view of components of a second linkage system.

[0091] FIG. 10A is a perspective view of the rifle with portions removed illustrating components of a third linkage system.

[0092] FIG. 10B is an exploded view of the components of the third linkage system.

[0093] FIG. 11 is a perspective view of a fourth linkage system.

[0094] FIGS. 12A and 12B are cross sectional views of the rifle illustrating the mechanisms in an in-battery and ready-to-fire mode.

[0095] FIG. 12C is a side elevational view of the exterior of the rifle when in the in-battery and ready-to-fire mode

[0096] FIGS. 13A and 13B are cross sectional views of the rifle illustrating the mechanisms in a firing mode with the firing pin extended forward.

[0097] FIGS. 14A and 14B are cross sectional views of the rifle illustrating the mechanisms after firing with the bolt handle unlocked ready for extraction, the bolt head still locked in the barrel extension.

[0098] FIGS. 15A and 15B are cross sectional views of the rifle illustrating the mechanisms with the handle rotated rearwardly moving the striker rearwardly compressing the firing pin spring and with the third linkage system pushing away from the receiver.

[0099] FIGS. 16A, 16B and 16C are cross sectional views of the rifle illustrating the bolt assembly pulled rearwardly.

[0100] FIGS. 17A-17D are a cross sectional views of the bolt head and bolt body being retracted illustrating the ejector mechanism motion for ejection of a cartridge.

[0101] FIG. 18 is a top plan view of the rearward end of the bolt assembly of the rifle.

[0102] FIG. 19 is a top plan view of the rifle of FIG. 18 with the safety selector in the safe mode.

[0103] FIG. 20 is a perspective view of the rifle with the bolt assembly pulled to a rearwardmost position.

[0104] FIG. 21 is a side elevational view of a bolt assembly with a bolt head thereon.

[0105] FIG. 22 is a side elevational view of the bolt assembly of FIG. 21 being inserted into a receiver.

[0106] FIG. 23 is a perspective view illustration the bolt handle being pushed forward.

[0107] FIG. 24 is a perspective view of the rifle of FIG. 23 with the bolt handle forward.

[0108] FIG. 25 is a side elevational view of a rifle with the thumb pushbutton being depressed.

[0109] FIG. 26 is a side elevational view of the rifle of FIG. 25 after the thumb pushbutton has been depressed.

[0110] FIG. 27 is a perspective view of a rifle with the bolt handle being pushed rearwardly and the thumb pushbutton being depressed.

[0111] FIG. 28 is a side view of a portion of a rifle showing the motions for releasing the bolt assembly.

[0112] FIG. 29 is a perspective view of the rearward portion of a bolt assembly of the rifle.

[0113] While the invention is amenable to various modifications and alternative forms, specifics thereof have been depicted by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0114] Referring to FIGS. 1A and 1B, a straight pull bolt action rifle **20** has a receiver **22** supported by a stock **24**, a barrel assembly **25** with a barrel **26** extending forward of the receiver **22**, a bolt assembly **30** with a bolt handle **32**, a bolt release button **36**, a safety tab **40**, and a releasable bolt stop **42** or bolt removal release lever, a lower frame **52** with an integral trigger guard **54** and magazine well **55**. The barrel and rifle have a longitudinal axis **al**. The rifle is configured for firing a first ammunition and receives a magazine **53** of said first ammunition **53.1**. The rifle is modular such that with minimal effort as described in more detail below, the rifle can be readily reconfigured with a kit **53.4** for a second ammunition **53.6** in a second magazine **53.7**. The kit comprising a second lower frame **52'**, a second barrel assembly **25'**, and second bolt head **53.8** (the first bolt head is not shown in FIGS. 1A and 1B).

[0115] Referring to FIGS. 2A to 2H, as well as the exploded FIG. 3, further portions and components of the firearm are illustrated, in particular those associated with the receiver **22**, the barrel assembly **25**, and bolt assembly **30**. The barrel **26** has a rearward threaded end **45** that connects to a threaded barrel extension **46** with a barrel nut **47** and barrel lug **48**; these components defining the barrel assembly **25**. The barrel extension **46** receives a forward end of the bolt assembly **30** as describe in further detail below. A trigger mechanism **50** is positioned below the bolt assembly above a lower frame **52** that has a trigger guard **54** and a magazine well **55** defining a magazine receiving region **56**. In embodiments, a magazine release lever **57** is nested about a forward portion of the trigger guard. The trigger mechanism **50** may include features of the AccuTrigger® system of Savage Arms, Inc., the owner of the instant application. See U.S. Pat. No. 6,553,706 incorporated by reference herein. The bolt assembly includes a bolt body **58** extending from a bolt mechanism housing **60** configured as a bulbous rearward bolt cap that contains bolt operation mechanism **64**. The bolt assembly disposed in the receiver secured to the stock. The stock includes components known as the AccuStock® system and AccuFit® systems by Savage Arms, Inc., see U.S. Pat. No. 10,690,440 incorporated herein by reference for all purposes.

[0116] The receiver **22** has a rearward end **65.1**, a mid-portion **67** with an ejection port **65.3**, and a forward end **69** with a forward face **70**. As best shown in FIG. 2G, a slit **70.5** may extend longitudinally

along a front clamping portion **71** of the receiver. The clamping portion **70** having an interior cylindrical surface **72** for engaging the cylindrical exterior surface **73** of the barrel extension **46** of a barrel assembly **25**. At the slit defining a C shape of the forward clamping portion, opposing clamping lugs **74.1**, **74.2** have holes **74.4** for screws **75.1** and barrel nuts **75.3** for pulling the opposing clamping lugs together about the barrel extension. The different barrel assemblies, for example for different sized ammunition, have identically configured and sized exterior surfaces and features so that all interface the same with the receiver at the forward face of the receiver providing the correct head space. The barrel lug **48** has a forward vertical rib **76** that interfaces with a vertical groove **77** on the forward face **70** of the receiver **22**. Moreover, the rearward facing surface **77.2** of the barrel lug interfaces with the flat forward surface **77.5** of the forward face **70** of the receiver **22**.

[0117] Referring to FIGS. 2C, 2F, and 2I, the barrel extension and receiver each have a vent hole **77.6**, **77.7** and the barrel extension has a circumferential thinned region **77.8** extending around the barrel extension and positioned about at the breech face **77.9** of the rifle. The cross section of FIG. 2I depicts the internal threaded portion **46.2** that cooperates with the threaded end of the barrel, a recess **46.3** for receiving the locking rollers of the bolt head **86**. The thinned region and vents provide a failure pathway in the unlikely event of a cartridge explosion at the breech face that is potentially less hazardous than without. The vents can lessen the explosive force, and the thinned region may facilitate the barrel dislocating from the rifle in the proximity of the thinned region **77.8** rather than having more severe damage rearward of the breech face.

[0118] Referring to FIGS. 2A, 2B, and 4A to 4C, a releaseable bolt stop **42** embodiment is depicted and generally comprises a bolt stop lever **42.1**, a bolt groove engaging plunger **42.2**, a plunger pin **42.3**, a pivot arm **42.4**, pivot arm pin **42.5**, and bias spring **42.6**. The components of the bolt stop are attached to the receiver **22** at a bolt stop lever recess **42.7**, as best shown in FIGS. 2B and 4B. The plunger **42.2** seats in the larger hole and rides in the bolt stop groove **42.8** in the bolt body **58**. When the bolt assembly is retracted, that is, moved rearwardly from the in battery position, the plunger will follow the bolt stop groove **58.1** in the bolt body until it reaches the stop surface **58.2** at the end of the bolt stop groove **42.8** such as is shown in FIG. 2D. The stop surface will stop the retraction. The user may raise the plunger from the groove and the stop surface by depressing the forward portion **42.9** of the lever **42.1** which then allows the bolt assembly to be removed from the receiver subject to other mechanism interconnections.

[0119] Referring to FIGS. 2D, 2E, and 4D-4G, another releaseable bolt stop **42'** is illustrated that is secured to a bolt stop insert **43.1** rather than directly to the receiver **22**. The insert may generally provide structural support to the receiver **22** and a slot **43.2** in the receiver **22** provides access to the bolt stop **42'** by a user. The releaseable bolt stop **42'** comprises a bolt stop lever **43.3** with a bolt stop groove engaging portion **43.4** and is pivotally and movably supported in a bolt stop recess **43.5** in the insert **43.1** by pins **43.6**, **43.7**. A spring **43.8** in conjunction with a bolt stop plunger **43.9** urge the lever **43.3** rearwardly in the recess of the insert **43.1** where, due to an L shaped slot **44.1** in the lever, the bolt stop groove engaging portion is constrained in the bolt stop groove **42.8** as shown in FIG. 4F where the insert has been removed for illustration. As the bolt assembly is retracted rearwardly, the bolt stop lever stays in the groove and abuts against the stop surface **58.2**, shown in FIG. 2D. To retract the bolt stop groove engaging portion from the groove, the user must first push the lever forwardly in the bolt stop recess **43.5** in the bolt stop insert and then may depress the forward end **44.3** of the lever to raise the rear end of the lever from the groove allowing the bolt assembly to be fully removed from the insert and receiver.

[0120] Referring to FIGS. 1A, 1B, 4H-4K, a magazine release mechanism **49** is illustrated that is attached to the lower frame **52** having the magazine well **55** and trigger guard **54**. The mechanism comprises a pivoting lever **49.1** pivotally attached by a pin **49.2** to the lower frame, a slider **49.3** that has a forward magazine catch **49.4**. The slider has tabs **49.5** that are received in a slot or slots **49.6** in the lower frame. An operating tab **49.6** of the pivoting lever loosely engages a slot **49.7** in the slider. The slider is constrained in the lower frame by said operating tab. A pair of finger buttons **49.8** nest around the finger guard at a narrowed region **49.9** of the forward strap. A coil spring **50.1** received in

an aperture of the slider and compressed against the lower frame urges the slider forwardly and the finger guards engaged against the trigger guard. This provides a less obtrusive magazine release button and provides more surface of the button compared to the surface of the trigger guard strap than conventional magazine releases thereby making actuation easier.

[0121] Referring to FIGS. 3, 5A-5J, the bolt assembly **30** has a bolt body **58**, a bolt plunger **78**, a firing pin **80** with a firing pin tip **81**, a striker **82**, a firing pin spring **84**, a first bolt head **86**. The bolt handle **32** has a manual grasping portion **90** including a knob **91** and a shaft portion **92** with splines **93** that engage with cooperating structure in the bolt operation mechanism **64** discussed below. The bolt body **58** with an open end **95** may receive a second bolt head **53.8** or alternate bolt heads **86.2** for different size cartridges, such which will typically be associated with changing out the barrel assembly as well. In embodiments, each bolt head **86** has cogs or lugs **95.1** extending radially outward that are received in keyed slots **95.2** in the open end of the bolt body. The bolt head may be inserted in an axial direction with respect to the open end of the bolt body and then rotated with respect to the bolt body **58** to position the lugs **95.1** axially behind the radially inward projections **95.3** at the bolt body open end. So positioned, the bolt head cannot be removed without partially rotating the bolt head. See FIG. 5H illustrating the retention position. The bolt head is secured in place by a latch **96** configured as a lever seated in a cutout **96.1** with a pivot pin **96.2**. The lever has an outward surface **96.3** that may be flush or recessed with the outward cylindrical surface **96.4** of the bolt body **58**. The latch forward end has a stop projection **96.5** that seats between the lugs or cogs of the bolt head in an obstruction position with regard to the bolt head rotation that has been inserted and partially rotated, thereby precluding the bolt head from rotating to a removal rotational position. Again, see FIG. 5H. FIG. 5H shows the rearward end **96.7** of the latch depressed, raising the forward end of the latch to a bolt head rotation position, a non obstructing position. The bolt head as illustrated in FIG. 5I has been rotated to a bolt head removal position and FIG. 5J illustrates the bolt head being pulled out of the open end **95** of the bolt body **58**.

[0122] The above operations may be performed only when the bolt assembly has been removed from the receiver. When the bolt body is in the receiver, the close tolerance between the exterior surface of the bolt body and the interior surface of the receiver, the latch cannot be moved from the obstruction position to the bolt head removal position. In other embodiments, the latch may simply have a radial inward projection that extends over a catch on the bolt head. The latch again needing to have it forward end raised to a non obstructing position to remove the bolt head.

[0123] Referring to FIGS. 2I, 5A, 6A-6H, the bolt heads have a plurality of circumferentially spaced apertures **96** that receive locking rollers **98** configured as spheres, or ball bearings, for engaging with recesses on the barrel extension, discussed below. When the bolt plunger **78**, specifically the bolt plunger head **78.1**, is fully engaged in the interior of the bolt head **86**, the roller bearings are forced outward to their fully radial extension position as shown and when in an in-battery position, engage a cooperating circumferential recess in the barrel extension. When the plunger is not present, either by retraction within the bolt body or by removal of the bolt head from the bolt body, the rollers are free to move radially inward.

[0124] Referring to FIGS. 6G and 6H, an extractor **99** is retained in each bolt head by way of a spring ring **99.2**.

[0125] Referring to FIGS. 2A, 2B, 6G, and 6I, an ejector **65** comprises an ejector bar **66** that pivots about post **65.2** and is spring biased by torsion spring **65.4**. The post is fixed to the receiver **22** at ejector mounting region **65.7** as best shown in FIG. 2B. The receiver is not shown in FIGS. 2A and 6A so it appears the ejector **65** is unattached, but it will be anchored to the receiver or other structure fixed with respect to the receiver. The forward end **65.5** of the ejector bar rides in the ejector slot **65.8** and is urged therein by the torsion spring. The ejector slot has an elevated portion **179** that acts as a cam surface when the forward end passes the raised portion and the rearward end of the ejector bar, as a cam follower, follows the raised portion and forces the forward end into the cartridge holding region of the bolt head to eject the cartridge therein. See the discussion below with reference to FIGS.

17A-17D.

[0126] Referring to FIGS. 7 and 8-11, the components of various sub-mechanisms or linkage systems that make up the bolt operation mechanism **64** and actuated by the bolt handle **32** are illustrated. The operation of the bolt operation mechanism including the linkage systems in various stages are illustrated in FIGS. 12A-17D.

[0127] FIGS. 12A-C Bolt assembly in a ready-to-fire and in-battery position

[0128] FIGS. 13A-B Trigger pulled releasing striker from sear and firing pin forward

[0129] FIGS. 14A-B Rotation of bolt handle rearward commencing ejection cycle and cocking, bolt head still locked

[0130] FIGS. 15A-B Further rotation of bolt handle to the rearwardmost position, the striker pulled fully rearward, bolt head released, gradual pushing off of receiver by bolt assembly

[0131] FIG. 16A-C Bolt assembly pulled rearwardly to the rearwardmost position ejecting any casing or cartridge that was in the chamber

[0132] The bolt handle **32** having a horizontal rotation axis at the rear bolt cap and an angular range **A1** of about the axis of about 45 degrees, plus or minus 15 degrees, in embodiments, see in particular, FIGS. 12C and 16C. In embodiments the bolt handle angular range of rotational motion is 30 degrees to 90 degrees as defined by a forwardmost rotational position **F1** and a rearwardmost rotational position **R1**. The bolt handle **32** connecting to a main rotatable drive member **100** within the mechanism enclosure **60**, rotatably connecting to the bolt body **58**. See FIGS. 5A-5C. The drive member **100** is connected to and initiates the four different linkage systems that providing the functionality of the bolt assembly in the rifle. Those functionalities can be described as follows: locking the bolt in the in-battery position, providing the gradual final locking of the bolt with the mechanism locking up in an over center arrangement, locking the bolt handle forwardly or rearwardly, unlocking the forward bolt handle manually or upon firing, gradually pushing off the receiver by the bolt assembly initiating the extraction phase, locking the bolt handle forwardly, and cocking the action.

[0133] As best shown in FIG. 9, the main rotatable drive member **100** has a barrel portion **101**, a first arm **102** with a pivot aperture **103**, a projection **105**, and a cam surface **106** all unitary with one another. Also extending outwardly from the barrel portion are a second arm **108** has a pivot aperture **110** and a bolt handle locking projection **112**. The main rotatable drive member has a central opening **107** that receives the shaft portion **92** of the bolt handle **32**.

[0134] Referring to FIGS. 8, 10A, 12A, 12B, components and interrelationships of a first linkage system **114** which is a sliding toggle mechanism with a first link **115** being the first arm of the main rotatable drive member **100**, the second link **116** pivotally pinned to the first link and also pivotally pinned to a slider at the other end, the slider being the bolt plunger **78**. The first and second links being constrained within the bolt assembly and having an over center position, see FIGS. 12A and 12B, that corresponds to the bolt plunger being extended and holding the locking roller balls into engagement with the barrel extension thereby locking the bolt head in the in-battery position. This position also correlates to the bolt handle in the forwardmost position. The second link also having cam surfaces **119** thereon that receive a bias inward toward the first link by a pusher member **121** that helps maintain the over center position of the linkage and maintains the bolt plunger as rearward as permitted by the positioning of the linkage. The pusher member slidably engaged with the striker **82** and a spring **123** positioned between the striker and the pusher member. The first linkage system for locking and releasing the bolt in the in-battery position and providing the reduced travel rate for said locking and releasing. The first linkage system also functions to facilitate locking the bolt handle in the rearward most position, see FIGS. 15A-16C.

[0135] A second linkage system **125** is illustrated in FIGS. 9 and 12A-16B and comprises the second

arm **108** of the main rotatable drive member **100**, an extraction plunger configured as an H-shaped connecting link **127** pivotally pinned to the second arm, and a catch link **129** with a catch portion **131** pivotally pinned to the H-shaped connecting link. In FIGS. 12A-13B, before the bolt handle **32** is rotated rearwardly, the catch portion **131** engages a catch surface **133** on a pin **134** on the receiver **22**. In FIGS. 15A and B, the second linkage system **125** is pushing off the receiver by way of the extraction plunger or connecting link **127** and/or the catch link **129** commencing the ejection cycle. The catch link **129** rotating clockwise urged by the spring **130** to move the catch portion **131** out of a catch position thereby allowing the bolt assembly to be slid rearwardly.

[0136] A third linkage system **133** is illustrated best in FIGS. 10A, 10B and 12A-16B, where the cam **105** of the main rotatable drive member **100** and two links, the striker **82** and firing pin **80** compress the firing pin spring **84** in preparation for firing, utilizing rotation of the bolt handle and the connected drive member **100**. The firing spring is anchored with respect to the bolt body by way of a firing spring mount **137**. The rotation of the main rotatable drive member, rotatably fixed to the bolt body, provides a cam surface of projection that pushes a first link (the striker) rearwardly. See FIGS. 13A-15B, the striker pinned to the firing pin such that as the striker and firing pin are pulled rearwardly within the bolt body the firing pin spring is compressed, the firing pin spring having a rearward end anchored to the bolt body. The striker is subsequently engaged by the sear to hold the firing pin spring in the compressed state see FIGS. 12A and 12B.

[0137] A fourth linkage system **140** is illustrated best in FIGS. 11 and 12A-16C. The fourth linkage system is a catch and release mechanism for locking the handle in the forwardmost position when the bolt is in the in-battery ready-to-fire position and for providing a push button release button accessible by the thumb for releasing the bolt handle from said position. The main rotatable member **100** providing a handle lock projection **141** that engages a cooperating projection **143** on a pushbutton lever **145** at a juncture **147**. See FIGS. 11 and 12B. The pushbutton lever **145** having a thumb pushbutton **150** that is pivotal by a pin **153** on the mechanism housing **60** at pin holes **157**. The lever is biased in clockwise direction (as seen in FIG. 12B) by torsion spring **149**. A actuation link **161** is loosely pinned to the push button lever **145** at elongate pin hole **163** having a cam follower surface **167** that is engaged by a cam surface **168** on the rearward end **169** of the striker **82** (see FIG. 10B), such that as the striker is pulled back by way of the third linkage, the push button actuation link causes a lower end of the thumb pushbutton lever to move towards the main rotatable member to catch and secure the handle lock projection **141**, see FIGS. 14B and 15B, locking the rotation of the rotatable member in place, thereby locking the bolt handle in the forwardly most position of the bolt handle. When locked, pushing the thumb button **150** rotates the pushbutton lever **145** clockwise thereby breaking the juncture **147** as shown in FIG. 12B. This allows the bolt handle to be rotated rearwardly from the forwardmost position (see FIGS. 12B and 12C) thereby rotating the main rotatable drive member **100** clockwise. This then actuates the first linkage system **114** described above to pull back the bolt plunger **78** thereby releasing the bolt head **86** and moreover, putting the front nose **171** of the bolt plunger **78** in an obstructing position with the firing pin flange **173** thereby precluding the firing pin tip from reaching a cartridge, providing a bolt handle operated safety, see FIG. 15A.

[0138] Referring to FIGS. 17A-17D, the ejection cycle is shown with the bolt assembly **30** being pulled rearwardly in the receiver **22**. The ejector **65** has an ejector bar **66** rides in a slot **68** in the bolt body **58** and bolt head and pivots about a post **65.2** supported by the receiver. A torsion spring **72** urges the forward ejector portion **74** toward the bolt body and keeps the ejector bar in the slot. A cam follower surface **177** on the ejector bar **66** follows the cam surface **178** defined by the slot **68** and the raised portion **179**. When the cam follower surface of the ejector bar engages the raised portion, an ejector portion **181** on the forward end of the ejector bar is forced inwardly into the ejector slot on the bolt head **86**. The camming action is supplemental to the inward urging of the ejector portion by the torsion spring **72**.

[0139] Additional operations of embodiments are described below. Referring specifically to FIGS. 18 and 19, the two position safety selector **40** is located at the rear of the receiver and can be operated with either hand. Pushing it either forward, away from the shooter, or rearward, towards the shooter,

will engage or disengage the safety. Sliding the Safety Selector forward, the indicator **202** is visible and the safety is off—Ready to Fire position—see FIG. 18. Sliding the Safety Selector rearward, the Red Indicator is hidden from view and the safety is on—Full Safe position—see FIG. 19. In embodiments, the safety blocks the trigger from moving and does not lock the bolt from moving. The bolt can be opened or closed with the safety selector **40** in either position.

[0140] Referring to FIGS. 20-22, the bolt may be installed as follows. For installation of the bolt, the safety selector **40** may be positioned in the position of FIG. 19, the full safety position, the bolt handle **32** assembly should be cocked with the bolt handle **32** rotated fully rearward with the extraction plunger **127** fully visible as in FIG. 20, the ejector slot **68** aligned as shown in FIG. 22. The bolt may be manipulated forward and the bolt stop release lever **43.3** will snap into the bolt stop groove **42.8**.

[0141] Referring to FIGS. 23-27, the bolt assembly **30** may be cycled as follows. With the safety selector **40** forward, and the bolt handle **32** forward as shown in FIGS. 23 and 24, the firearm is ready to fire if a cartridge is in the chamber. With the firearm cocked, the thumb pushbutton **150** is in the near vertical position as shown in FIG. 25. When the firearm has been fired the pushbutton **150** will be forward and no longer vertical as shown in FIG. 26. The pushbutton **150** is thus a cocking indicator that visually shows when the firearm is cocked or not. The pushbutton also acts as a release button, which in embodiments, will allow the bolt to be unlocked and pulled rearward if the firearm has not been fired. With the safety selector **40** rearward in the FULL SAFE position, the top of the pushbutton may be depressed, and the bolt handle pulled rearwardly.

[0142] Referring to FIG. 28, the bolt assembly **30** may be removed by putting the safety selector in the FULL SAFE position, with the bolt assembly **30** at its rearwardmost position, pushing the bolt stop lever forward and depressing it releases the bolt assembly and the bolt assembly may be pulled rearwardly.

[0143] The positioning of the bolt handle **32** may be accomplished in embodiments as follows. Referring to FIGS. 5A-5G and 29 after removing the bolt assembly **30** from the receiver **22** as described above, the bolt handle may be rotated rearwardly and then by slightly depressing the extraction plunger **127** the urges the bolt handle to slowly rotate forward, uncocking the bolt assembly. The tip **207** of plunger **209** is exposed on the end of the bolt handle shaft portion **92** centrally positioned within the bolt handle cap **212**. The plunger is spring loaded by spring **214** and secured in the bolt handle shaft portion by pin **217**. Depressing the tip **207** of the plunger allows the cap **212** to slide off as best illustrated by FIGS. 5F and 5G. The bolt handle post **219** may be removed by unscrewing it from the bolt handle shaft portion **92**. The bolt handle **32** may then be removed from the right side of the bolt assembly **25**, and either reinserted with a different angular position in the right side of the bolt assembly or it may be moved to the left side of the bolt assembly with a desired angular positioning. The bolt handle post **219** is screwed back on and the bolt handle cap **212** is slide back onto the projections on the bolt handle post **219** retained thereon by the spring loaded plunger **209**.

[0144] The following United States patents are hereby incorporated by reference herein: U.S. Pat. Nos. 1,568,635, 3,257,749, 3,341,963, 3,653,140, 4,547,988, 4,672,762, 6,393,961, 9,115,941, 9,513,076, 9,599,417, 9,810,496, U.S. Ser. No. 10/077,957, U.S. Ser. No. 10/247,500. Components illustrated in the incorporated by reference references may be utilized with embodiments herein. Incorporation by reference is discussed, for example, in MPEP section 2163.07(B). The above references to U.S. patents in all sections of this application are herein incorporated by references in their entirety for all purposes.

[0145] All of the features disclosed, claimed, and incorporated by reference herein, and all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. Each feature disclosed in this specification may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature

disclosed is an example only of a generic series of equivalent or similar features. Inventive aspects of this disclosure are not restricted to the details of the foregoing embodiments, but rather extend to any novel embodiment, or any novel combination of embodiments, of the features presented in this disclosure, and to any novel embodiment, or any novel combination of embodiments, of the steps of any method or process so disclosed.

[0146] Although specific examples have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement calculated to achieve the same purpose could be substituted for the specific examples disclosed. This application is intended to cover adaptations or variations of the present subject matter. Therefore, it is intended that the invention be defined by the attached claims and their legal equivalents, as well as the illustrative aspects. The above described embodiments are merely descriptive of its principles and are not to be considered limiting. Further modifications of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the inventive aspects.

Claims

1. A straight pull bolt action rifle comprising: a stock, a receiver supported by the stock, a barrel extending from the receiver, a trigger mechanism below the receiver, a bolt action above the trigger mechanism and removably contained within the receiver, wherein the bolt action comprises: a rearward mechanism housing containing a bolt operation mechanism, a bolt body extending forwardly from the rearward mechanism housing and bolt operation mechanism, the bolt operation mechanism having a main rotatable member with horizontal axis of rotation that is transverse to a longitudinal axis of the rifle when the rifle is positioned with the longitudinal axis horizontal, the main rotatable member accessible from both the right side of the rifle and the left side of the rifle, a bolt handle attachable to the main rotatable member on both the right side and the left side of the rifle.
2. The straight pull bolt action rifle of claim 1, wherein the main rotatable member has a central hole coaxial with the axis of rotation, the main rotatable member having circumferential splines about the hole, and wherein the bolt handle has a shaft portion conforming to the central hole and wherein the shaft portion is attachable at the hole and is angularly adjustable therein.
3. The straight pull bolt action rifle of claim 1, wherein the mechanism translates rotation of the bolt handle connected to the main rotatable member and has a means for locking the bolt in the in-battery position, providing the final locking of the bolt with a plunger a gradual final locking, unlocking the bolt from the in-battery position manually or upon firing, manually unlocking the bolt at the in-battery position at a gradual reduced travel rate, locking the bolt handle forwardly, and releasing the forward locked bolt handle manually,
4. The straight pull bolt action rifle of claim 1, wherein the mechanism translates rotation of the bolt handle connected to the main rotatable member and has a means for: causing release of the forward locked bolt handle by pulling the trigger, providing a manual gradual initial push off of the bolt assembly from the receiver when the bolt assembly is at a closed most forwardly position of the bolt assembly after firing or after a manual bolt handle release, locking the bolt handle in the rearward rotational position, unlocking the bolt handle from the rearward rotational position, and retracting the striker thereby compressing the firing pin spring.
5. The straight pull bolt action rifle of claim 1, wherein the bolt operation mechanism has a bolt release thumb button on a rearward side of the bolt operation mechanism, the thumb button operably reachable by a user's thumb of the user's hand when the user's fore finger of said hand is extending partially around the bolt handle.
6. The straight pull bolt action rifle of claim 1, wherein the bolt handle has a manual grasping portion and a shaft portion, the manual grasping portion is on one side of the bolt assembly and the shaft portion extends through the main rotatable member to the side opposite the one side and is secured in place by an attachment piece.

7. The straight pull bolt action rifle of claim 6 wherein the attachment piece is a detent secured cap.

8. (canceled)

9. A straight pull bolt action rifle comprising: a stock, a receiver supported by the stock, a barrel extending from the receiver, a trigger mechanism below the receiver, a bolt action above the trigger mechanism and removably contained within the receiver, wherein the bolt action comprises: a rearward mechanism housing containing a bolt operation mechanism, a bolt portion extending forwardly from the rearward mechanism housing and bolt operation mechanism, wherein the bolt portion comprises a bolt body with an open front end for receiving a bolt head, the bolt head having a plurality of extendable roller balls spaced around the circumference for locking the bolt portion to the barrel or barrel extension, the bolt head replaceable with other bolt heads configured for different sized cartridges, the bolt body having a lever flush with or below an exterior surface of the bolt body, the lever having a forward projection for engaging with the bolt head whereby depression of the lever disengages the forward projection from the bolt portion allowing the removal of the bolt head from the bolt body.

10. The straight pull rifle of claim 9, wherein the bolt head connects with the bolt body by insertion and a partial rotation and wherein the projection engaged with the bolt head precludes the bolt head from rotating.

11. The straight pull rifle of any of claim 9, wherein the bolt operation mechanism comprises a sliding toggle linkage with an over center position, the linkage including a sliding link configured as a plunger with a tapered tip for extending the plurality of extendable roller balls outwardly for locking the bolt head in the barrel or a barrel extension.

12. A rifle comprising a straight pull bolt assembly in a receiver mounted to a stock, a trigger mechanism positioned below the bolt assembly, a barrel and barrel extension secured forward of the receiver to receive a bolt head of the bolt assembly, the bolt assembly comprising a bolt carrier containing a bolt body, a bolt head, a bolt plunger, a striker, a firing pin, a firing pin spring, a rear bolt mechanism enclosure, a bolt operation mechanism in the enclosure, a bolt handle connecting to the bolt operation mechanism at the rear bolt enclosure.

13. The rifle of claim 12, wherein the bolt head having a plurality of locking roller balls that are releasably engageable with recesses in the barrel extension and lockable therein by the bolt plunger.

14. The straight pull rifle of claim 9, wherein the bolt operation mechanism comprises a sliding toggle linkage with an over center position, the linkage including a sliding link configured as a plunger with a tapered tip for extending the plurality of extendable roller balls outwardly for locking the bolt head in the barrel or a barrel extension upon rotation of the bolt handle.

15. The straight pull rifle of claim 9, wherein the bolt operation mechanism comprises a second linkage that provides a gradual push off of the bolt assembly from the receiver upon rotation of the bolt handle.

16-17. (canceled)

18. The firearm of claim 12, wherein the bolt plunger captured by the bolt body, the bolt plunger having a tapered forward surface for engaging the locking rollers and pushing each of the locking rollers to a radially outward position in the respective apertures for providing a locking engagement with the barrel.

19. The firearm of claim 18, wherein the bolt assembly further comprises a bolt handle member extending laterally with respect to the bolt body, the handle member being selectable attachable to a left side portion of the bolt body or a right side portion of the port body to provide ambidextrous operation of the firearm.

20-32. (canceled)

33. The straight pull rifle of claim 1, wherein an ejector lever is pivotally connected to the receiver and is engaged with a slot in the bolt assembly, the slot extending to the cartridge head receiving region on the bolt head, wherein when a cartridge or casing is in the cartridge head receiving region and the bolt assembly is pulled rearwardly, the cartridge or casing is ejected by the ejector lever.

34-51. (canceled)

52. The bolt action rifle of claim 1, wherein the bolt handle has a manual grasping portion and a shaft portion, the manual grasping portion is on one side of the bolt assembly and the shaft portion extends through the main rotatable member to the side opposite the one side and is secured in place by an attachment piece, and wherein the manual grasping portion and shaft portion can be moved to the opposite side without using tools.

53. (canceled)

54. The straight pull rifle of claim 1, wherein the bolt operation mechanism comprises a sliding toggle linkage with an over center position, the linkage including a sliding link configured as a plunger with a tapered tip for extending the plurality of extendable roller balls outwardly for locking the bolt head in the barrel or a barrel extension upon rotation of the bolt handle.

55. The straight pull rifle of claim 1, wherein the bolt operation mechanism comprises a second linkage that provides a gradual push off of the bolt assembly from the receiver upon rotation of the bolt handle.